**Objection under 35 U.S.C. 103(a) as being unpatentable over Miyasato et al. (U.S. Patent No. 5,865,911) in view of 2002 Bushmaster arms catalog.**

The Applicants respectfully request reconsideration and withdrawal of this objection for the following reasons:

Miyasato et al. clearly teaches a process for producing aluminum alloy structural members for aircraft and teaches many processing steps that are similar to that of the present invention. He also states a specific yield strength value of at least 62 ksi in the specification and selected claims.

Bushmasters Firearms catalog 2002 teaches the use of aircraft quality 7075 in a T6 temper for its gun receivers. Bushmaster also teaches that the gun receivers may be forged. The T6 temper inherently includes the steps of solution heat treatment, quenching and artificial aging.

The Patent Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the aluminum alloy of Miyasato et al. to manufacture firearms parts as taught by Bushmaster.

**The combination of the Miyasato et al. teaching to manufacture firearms parts as taught by Bushmaster would be an inoperable combination. The Miyasato alloy, as used by Bushmaster would not achieve the strength required to produce the current invention.**

The Applicants respectfully submit that alloy formulations with a yield strength value of at least 62 ksi have been prominently used as gun frames and gun components for many years. Alloy 7075, utilized by Bushmaster Firearms, is also widely used by other gun manufacturers. Significantly, alloy 7075 does have a yield strength value of at least 62 ksi, for example, the Aluminum Handbook states a yield strength value of 73 ksi for alloy 7075. The Applicants discuss alloy 7075 in some detail in the specification of the patent and its prominent use in pistol frames and low caliber revolvers.

In the case of heavy caliber handguns, the Applicants stated the following in the specification:

*"Often, the 7075 frames break after just a few test firings, thereby excluding this material as a candidate for heavy caliber revolvers. In contrast, the gun frame comprised of the lightweight alloy stock of this invention withstood extensive test firings. Specifically, a .357 Magnum was mounted in a gun vise and subjected to 3000 rounds using an ultra-high caliber 158-grain .357 load. Even though this test is the equivalent of 9000 hand-fired rounds, the gun held up to this extensive number of firing cycles. Previously, only steel and titanium alloys have withstood such rigorous testing. It is significant that the starting stock of this invention can withstand the repeated firing loads since the gun*

*frame is just one-third the weight of steel handgun frames and 70% lighter that titanium alloy frames."*

**Lack of Implementation of Prior Art, Current Invention Teaches a Solution of a Long-Felt and Unsolved Need.**

Miyasato et al., as stated by the Patent Examinor, did not anticipate that their invention for aircrafts structural members would be applicable to a gun frame or gun component. The patent assignee of the Miyasato et al. patent, the Aluminum Company of America, has sold aluminum alloys to gun manufactures for nearly 50 years. Alloy 7075 is the leading alloy that is now provided into this industry. If one skilled in the art were to take the alloy of the Miyasato et al., and attain a yield strength of at 62 ksi, the use of this material in a heavy caliber handgun frame would result in failure after just a few rounds of firing. Widely used alloy 7075, which has a higher yield strength value (73 ksi) than that proposed by Miyasato, has historically failed in firing trials within a few rounds. In contrast, the current invention provides a material that can last for >9000 hand fired rounds. With regard to the relatively smaller caliber handguns, the present invention allows for downsizing to smaller dimensions that cannot be achieved with alloy 7075.

**Multiplicity of Steps**

The Applicants also submit that the multiplicity of steps required in the present invention have not been previously stated in the prior art. Miyasato et al. state similar processing steps in their specification. Nevertheless, we do not recognize an instance whereby the sequence proposed in the present invention is specifically stated by the teaching of Miyasato et al. This is particularly evident in the fact that the Applicants proposed claims are relevant only to gun frames and gun components and only at yield strength values greater than 80 ksi.

**Commercial Success and Professional Recognition of Present Invention.**

The Applicants invention is now commercially used by Smith & Wesson as the frame material in several revolver models. A feature article states the following:

*"Of course the aluminum frame/titanium cylinder design of the S&W Air-Lite Ti or the Taurus MultiAlloy offereings do have limitations – most obviously, no magnum chamberings. Titanium cylinders can be made more that strong enough to hand loads up to and including .357 Magnium, .41 Magnum and .44 Magnum, but typical firearms-grade aluminum alloy frames absolutely cannot – which is why there have never been any Airweight type aluminum frame/steel cylinder magnum revolvers in the first place." (Shooting Times, October 2000, pp 42-45).*

Smith & Wesson is clearly one of the premier gun manufacturers in the world and was the pioneer in handgun development starting in 1852. Smith & Wesson also employed

aluminum alloys in handguns as early as 1952. Since that time, however, alloy 7075 has been the state-of-the-art in handguns frames. Nevertheless, the fact that alloy 7075 handgun frames will fracture when heavy caliber rounds are utilized has eliminated the consideration of this alloy for the heavy caliber handguns. Accordingly, gun designers at Smith & Wesson have never been able to lightweight their heavy caliber handguns.

**Unexpected Results for the Present Invention**

The Applicants have provided the current invention to Smith & Wesson, and the invention has lead to performance levels that were previously unattainable in their product engineering history. Smith & Wesson currently markets this innovation as their "AirLite Sc" models, and the product has attained commercial success. As stated in the current invention, *a lightweight alloy is now being used for the first time in heavy caliber handguns*. The method to produce lightweight gun frames and gun components is also employed to produce handgun cylinders, an unprecedented use of a lightweight alloy. Smith & Wesson also used the principles of this invention to redesign the gun frames of the smaller caliber handguns that were previously comprised of 7075. In this instance, the gun frames are smaller, thereby taking advantage of the higher strength afforded by this invention.

The Applicants submit that two significant results in the current patent application are unexpected results. First, while the increased strength was remarkable, the method to produce the starting stock for the gun frame would not previously be expected to withstand the repeated firing loads, an accomplishment that has heretofore been achieved only through the use of steel or titanium alloys. The fact that the current invention was utilized in a heavy caliber handgun that survived 9000 rounds of firing was a surprising result to the engineering staff at Smith & Wesson. Second, the fact that higher strength was attained would not guarantee the effectiveness of this invention to be utilized as the material of construction for the gun cylinder. In this environment, the high temperature and high velocity of the bullet discharge gases cause erosion of the interior of the cylinder when aluminum alloys are employed. Again, this application was previously the domain of steel and titanium alloys. By contrast, the current invention is already successfully employed as a gun cylinder in many Smith & Wesson models.

To underscore the importance of the different uses of the present invention, the Applicants submit that commercialization of this invention is in the early stages whereby designers are now recognizing the previously unappreciated advantage of employing this process in the production of many different gun frames and gun components. For example, the Bushmaster example stated by the Patent Examiner currently utilizes alloy 7075. If Bushmaster seeks to reduce the size of this component, they will reach a point where the 7075 cannot withstand the forces that are applied during operation. At that point, the present invention can be utilized, thereby enabling Bushmaster to achieve new performance levels.

**Note: We have enclosed supporting material to the Patent Examiner that demonstrates the commercial success of this invention.**

9. The prior art made of record and not relied upon is considered pertinent to the applicant's disclosure.

The Applicants agree that Shahani et al. (U.S. Patent No. 6,027,582 and Hunt, Jr. et al. (U.S. Patent No. 5,221,377) is pertinent to the Applicants disclosure.

**Conclusion**

For the above reasons, the applicant submits that the claims are now in proper from, and that the claims all define patentability over the prior art. Therefore, the applicant submits that this application is now in condition for allowance, which action they respectfully solicit.

**Conditional Request for Constructive Assistance**

The applicant has amended the claims of this application so that they are proper and define a novel invention that is also non-obvious. If, for any reason this application is not believed to be in full condition for allowance, applicant respectfully requests the constructive assistance and suggestions of the Examiner in order that the undersigned can place this application in allowable condition as soon as possible and without the need for further proceedings.

Very respectfully,

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22 May 2002

Wm. Troy Tack, Applicant

7075 Strength Reference

#4

# ASM Specialty Handbook®

## Aluminum and Aluminum Alloys

**Edited by**
**J.R. Davis**
**Davis & Associates**

Prepared under the direction of the
ASM International Handbook Committee

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**Table 108 Tensile properties of alloy 7075**

| Temper | Tensile strength MPa | Tensile strength ksi | Yield strength MPa | Yield strength ksi | Elongation(a), % |
|---|---|---|---|---|---|
| **Typical properties** | | | | | |
| O | 228 | 33 | 103 | 15 | 17 |
| T6, T651 | 572 | 83 | 503 | 73 ← highest reported | 11 |
| T73 | 503 | 73 | 434 | 63 | ... |
| Alclad O | 221 | 32 | 97 | 14 | 17 |
| T6, T651 | 524 | 76 | 462 | 67 | 11 |
| **Property Limits** | Minimum | | Minimum | | Minimum |
| **Sheet and plate** | | | | | |
| O | 276 (max) | 40 (max) | 145 (max) | 21 (max) | 10 |
| **Sheet** | | | | | |
| T6, T62 | | | | | |
| 0.008–0.011 in. thick | 510 | 74 | 434 | 63 | 5 |
| 0.012–0.039 in. thick | 524 | 76 | 462 | 67 | 7 |
| 0.040–0.125 in. thick | 538 | 78 | 469 | 68 | 8 |
| 0.126–0.249 in. thick | 538 | 78 | 476 | 69 | 8 |
| T73 | 462 | 67 | 386 | 56 | 8 |
| T76 | 503 | 73 | 427 | 62 | 8 |
| **Plate** | | | | | |
| T62, T651 | | | | | |
| 0.250–0.499 in. thick | 538 | 78 | 462 | 67 | 9 |
| 0.500–1.000 in. thick | 538 | 78 | 469 | 68 | 7 |
| 1.001–2.000 in. thick | 531 | 77 | 462 | 67 | 6 |
| 2.001–2.500 in. thick | 524 | 76 | 441 | 64 | 5 |
| 2.501–3.000 in. thick | 496 | 72 | 421 | 61 | 5 |
| 3.001–3.500 in. thick | 490 | 71 | 400 | 58 | 5 |
| 3.501–4.000 in. thick | 462 | 67 | 372 | 54 | 3 |
| T7351 | | | | | |
| 0.250–2.000 in. thick | 476 | 69 | 393 | 57 | 6–7 |
| 2.001–2.500 in. thick | 455 | 66 | 359 | 52 | 6 |
| 2.501–3.000 in. thick | 441 | 64 | 338 | 49 | 6 |
| T7651 | | | | | |
| 0.250–0.499 in. thick | 496 | 72 | 421 | 61 | 8 |
| 0.500–1.000 in. thick | 490 | 71 | 414 | 60 | 6 |
| **Alclad sheet and plate** | | | | | |
| O | | | | | |
| 0.008–0.062 in. thick | 248 (max) | 36 (max) | 138 (max) | 20 (max) | 9–10 |
| 0.063–0.187 in. thick | 262 (max) | 38 (max) | 138 (max) | 20 (max) | 10 |
| 0.188–0.499 in. thick | 269 (max) | 39 (max) | 145 (max) | 21 (max) | 10 |
| 0.500–1.000 in. thick | 276 (max) | 40 (max) | ... | ... | 10 |
| **Alclad sheet** | | | | | |
| T6, T62 | | | | | |
| 0.008–0.011 in. thick | 469 | 68 | 400 | 58 | 5 |
| 0.012–0.039 in. thick | 483 | 70 | 414 | 60 | 7 |
| 0.040–0.062 in. thick | 496 | 72 | 427 | 62 | 8 |
| 0.063–0.187 in. thick | 503 | 73 | 434 | 63 | 8 |
| 0.188–0.249 in. thick | 517 | 75 | 441 | 64 | 8 |
| T73 | | | | | |
| 0.040–0.062 in. thick | 434 | 63 | 352 | 51 | 8 |
| 0.063–0.187 in. thick | 441 | 64 | 359 | 52 | 8 |
| 0.188–0.249 in. thick | 455 | 66 | 372 | 54 | 8 |
| T76 | | | | | |
| 0.125–0.187 in. thick | 469 | 68 | 393 | 57 | 8 |
| 0.188–0.249 in. thick | 483 | 70 | 407 | 59 | 8 |
| **Alclad plate** | | | | | |
| T62, T651 | | | | | |
| 0.250–0.499 in. thick | 517 | 75 | 448 | 65 | 9 |
| 0.500–1.000 in. thick | 538(b) | 78(b) | 469(b) | 68(b) | 7 |
| 1.001–2.000 in. thick | 531(b) | 77(b) | 462(b) | 67(b) | 6 |
| 2.001–2.500 in. thick | 524(b) | 76(b) | 441(b) | 64(b) | 5 |
| 2.501–3.000 in. thick | 496(b) | 72(b) | 421(b) | 61(b) | 5 |
| 3.001–3.500 in. thick | 490(b) | 71(b) | 400(b) | 58(b) | 5 |
| 3.501–4.000 in. thick | 462(b) | 67(b) | 372(b) | 54(b) | 3 |
| T7351 | | | | | |
| 0.250–0.499 in. thick | 455 | 66 | 372 | 54 | 8 |
| 0.500–1.000 in. thick | 476 | 69 | 393 | 57 | 7 |
| T7651 | | | | | |
| 0.250–0.499 in. thick | 476 | 69 | 400 | 58 | 8 |
| 0.500–1.000 in. thick | 490(b) | 71(b) | 414(b) | 60(b) | 6 |

(a) In 50 mm (2 in.) or 4*d*, where *d* is diameter of reduced section of tensile test specimen. Where a range appears in this column, the specified minimum elongation varies with thickness of the mill product. (b) For plate 13 mm (0.500 in.) or over in thickness, listed properties apply to core material only. Tensile and yield strengths of composite plate are slightly lower than listed value, depending on thickness of cladding.

## Thermal Properties

*Liquidus temperature*. 657 °C (1215 °F)
*Solidus temperature*. 641 °C (1185 °F)
*Coefficient of thermal expansion*. Linear:

| Temperature range °C | Temperature range °F | Average coefficient μm/m · K | Average coefficient μin./in. · °F |
|---|---|---|---|
| −50 to 20 | −58 to 68 | 21.8 | 12.1 |
| 20 to 100 | 68 to 212 | 23.6 | 13.1 |
| 20 to 200 | 68 to 392 | 24.5 | 13.6 |
| 20 to 300 | 68 to 572 | 25.5 | 14.2 |

Volumetric: $68 \times 10^{-3}$ $m^3/m^3 \cdot K$ ($3.78 \times 10^{-5}$ $in.^3/in.^3 \cdot °F$) at 20 °C (68 °F)
*Specific heat*. 893 J/kg · K (0.213 Btu/lb · °F) at 20 °C (68 °F)
*Thermal conductivity*. O temper: 227 W/m · K (131 Btu/ft · h · °F) at 20 °C (68 °F)

## Electrical Properties

*Electrical conductivity*. Volumetric, O temper: 60% IACS at 20 °C (68 °F)
*Electrical resistivity*. 28.7 nΩ · m at 20 °C (68 °F); temperature coefficient, 0.1 nΩ · m per K at 20 °C (68 °F)
*Electrolytic solution potential*. −0.96 V versus 0.1 *N* calomel electrode in an aqueous solution containing 53 g NaCl plus 3 g $H_2O_2$ per liter at 25 °C (77 °F)

## Chemical Properties

*General corrosion behavior*. High resistance to general corrosion. Provides galvanic protection when used as cladding on several different alloys

## Fabrication Characteristics

*Annealing temperature*. 345 °C (650 °F)

# 7075, Alclad 7075
# 5.6Zn-2.5Mg-1.6Cu-0.23Cr

## Specifications

*AMS*. See Table 106.
*ASTM*. See Table 106.
*SAE*. J454
*UNS number*. A97075
*Government*. See Table 106.
*Foreign*. Austria: Önorm AlZnMg-Cu1.5. Canada: CSA ZG62, ZG62Alclad. France: NF A-Z5GU. Spain: UNE L-371. Switzerland: VSM Al-Zn-Mg-Cu; Alclad, Al-Zn-Mg-Cu-pl. United Kingdom: BS L.95, L.96. Germany: DIN AlZnMgCu1.5; Werkstoff-Nr. 3.4365. ISO: AlZn6MgCu

## Chemical Composition

*Composition limits of 7075*. 1.20 to 2.0 Cu, 2.1 to 2.9 Mg, 0.30 Mn max, 0.40 Si max, 0.50 Fe max, 0.18 to 0.28 Cr, 5.1 to 6.1 Zn, 0.20 Ti max, 0.05 max other (each), 0.15 max others (total), bal Al
*Composition limits of Alclad 7075*. 7072 cladding—0.10 Cu max, 0.10 Mg max, 0.10 Mn max, 0.7 Si max + Fe, 0.8 to 1.3 Zn, 0.05 max other (each), 0.15 max others (total), bal Al